

Claims:

1. Device for providing spongy bone with bone substitute and/or bone reinforcing material,

wherein at least one perforating device (4) is provided for making at least one hole (5) in the spongy

5 bone (1), and

wherein at least one flushing or rinsing device (6) is provided for flushing or rinsing the hole (5) with a rinsing agent (7),

characterized in

10 that at least one vacuum source (9) is provided for generating a vacuum in the hole (5) in the spongy bone (1) for sucking and/or facilitating insertion or feeding of the bone substitute and/or bone reinforcing material (3) into said spongy bone (1).

15 2. Device according to claim 1, characterized in that the vacuum source (9) is provided to generate a vacuum in the hole (5) of the spongy bone (1) such that the bone substitute and/or bone reinforcing material (3) is sucked into said hole (5) and

20 distributed therein.

3. Device according to claim 1 or 2, characterized in that the vacuum source (9) is provided to generate a vacuum in the hole (5) of the spongy bone (1) such that the bone substitute and/or bone reinforcing material (3) is sucked into said hole (5) and

25 distributed therein without substantial portions thereof being sucked out of the hole (5).

30 4. Device according to any preceding claim, characterized in that the vacuum source (9) is provided to suck tissue material out of the hole (5) of the spongy bone (1) before bone substitute and/or bone reinforcing material (3) is sucked into the spongy bone (1).

35 5. Device according to any preceding claim, characterized in that a collecting device (27) is provided to collect tissue material which by the

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vacuum source (9) has been sucked out of the hole (5) of the spongy bone (1) for preventing tissue material from being sucked into the vacuum source (9) and/or into a monomer filter (28) and/or into a bacteria filter (29).

5 6. Device according to any preceding claim, characterized in that a monomer filter (28) is provided for preventing poisonous gases, which are generated during production of bone substitute and/or bone reinforcing material (3) from being discharged into 10 the surroundings.

15 7. Device according to any preceding claim, characterized in that a bacteria filter (29) is provided for preventing bacteria from getting into the hole (5) of the spongy bone (1) if a connection between the vacuum source (9) and the spongy bone (1) is opened unintentionally.

20 8. Device according to any preceding claim, characterized in that a non-return valve device (26) is provided to prevent tissue material and/or any other material and/or bacteria from being sucked into the hole (5) of the spongy bone (1) if the connection between the vacuum source (9) and the hole (5) in the spongy bone (1) is opened unintentionally.

25 9. Device according to claims 5 and 8, characterized in that the non-return valve device (26) is located between the hole (5) in the spongy bone (1) and the collecting device (27).

30 10. Device according to any of claims 5-9, characterized in that the non-return valve device (26) is located between the monomer filter (28) and/or the bacteria filter (29) and the hole (5) in the spongy bone (1).

35 11. Device according to any preceding claim, characterized in that a container (18) for producing and/or storing bone substitute and/or bone reinforcing material (3) is provided with a feeding device (30) for feeding bone substitute and/or bone reinforcing

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material (3) out of the container (18) and into the hole (5) of the spongy bone (1) at the same time the vacuum source (9) generates a vacuum therein.

12. Device according to any preceding claim, characterized in that a container (18) for producing and/or storing bone substitute and/or bone reinforcing material (3) is provided with a feeding device (30) for feeding bone substitute and/or bone reinforcing material (3) into the hole (5) of the spongy bone (1) after the vacuum source (9) has generated a vacuum therein.

13. Device according to claim 11 or 12, characterized in that the feeding device (30) is manually operable.

14. Device according to any preceding claim, characterized in that the vacuum source (9) is provided to generate a vacuum of between 0,5 bar and 0,92 bar in the hole (5) of the spongy bone (1).

15. Device according to claim 14, characterized in that the vacuum source (9) is provided to generate a vacuum of between 0,7 and 0,8 bar in the hole (5) of the spongy bone (1).

16. Device according to any preceding claim, characterized in that a valve device (32) is provided to close or interrupt the supply of bone substitute and/or bone reinforcing material (3) to the hole (5) of the spongy bone (1) until the vacuum source (9) has generated a suitable vacuum therein and that the valve device (32) is provided to be opened to permit supply of bone substitute and/or bone reinforcing material (3) such that said material can be sucked into the hole (5) of the spongy bone (1) when said suitable vacuum has been measured therein.

17. Device according to any preceding claim, characterized in that at least a first and a second cannula or needle (19, 20) are insertable into the spongy bone (1) such that they are simultaneously directed into the hole (5) thereof and that the first

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cannula or needle (19) is connected to a container (18) for producing and/or storing the bone substitute and/or bone reinforcing material (3) while the second cannula or needle (20) is connected to the vacuum source (9).

5 18. Device according to claim 17, characterized in that the flushing or rinsing device (6) comprises a rinsing agent container (16) which is connected to the first cannula or needle (19) for leading rinsing agent (7) into the hole (5) of the spongy
10 bone (1) through said first cannula (19) and out of said hole (5) to the second cannula or needle (20).

19. Device according to claim 18, characterized in that a valve device (32) is provided to either open for supply of bone substitute and/or bone
15 reinforcing material (3) or of rinsing agent (7) through the first cannula or needle (19).

20. Device according to any preceding claim, characterized in that the rinsing device (6) is provided to flush or rinse the sides (5a) of the
20 hole (5) so that tissue material and other material are flushed away therefrom such that depressions (5b) are formed therein, into which the bone substitute and/or bone reinforcing material (3) can penetrate.

21. Device according to any preceding claim, characterized in that a vacuum source (9) is provided to suck rinsing agent (7) through the hole (5) in the spongy bone (1).

22. Device according to claim 21, characterized in that the vacuum source (9) for sucking rinsing agent (7) through the hole (5) in the spongy bone (1) is the same vacuum source which is used for sucking and/or facilitating insertion or feeding of bone substitute and/or bone reinforcing material (3) into said hole (5).

35 23. Device according to any preceding claim, characterized in that the perforating device (4) comprises an outer tube member (11) which

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can be located at the spongy bone (1), and a perforating means (12) which is movable in said outer tube member (11) in coaxial and/or rotary direction and which includes and/or cooperates with a perforating member (13) for
5 making the hole (5) in the spongy bone (1).

24. Device according to claim 23, characterized in that the perforating means (12) comprises an inner tube member (15) for leading rinsing agent (7) into or out of the hole (5) in the spongy bone (1).

10 25. Device according to claim 23 or 24, characterized in that the outer or inner tube member (11 or 15) is connected to a vacuum source (9) for sucking rinsing agent (7) through the hole (5) in the spongy bone (1) and out of said hole through the
15 outer tube member (11).

26. Device according to any preceding claim, characterized in that the perforating device (4) can be provided with or comprises several units for making at least two holes (5) in the spongy
20 bone (1) either by said holes extending into each other or by having such spongy bone (1) between them which can be penetrated by air and provided with bone substitute and/or bone reinforcing material (3).

27. Device according to any preceding claim,
25 characterized in that the vacuum source (9) is an injector pump (21) which is operated by a compressed medium.

28. Device according to claim 27, characterized in that the injector pump (21) can
30 be connected to a compressed-medium device (22) which is designed as a compressed-air device which is provided in localities in or close to which the vacuum source (9) shall be used.

29. Device according to claim 28, characterized in that the injector pump (21) can be
35 connected to a compressed-medium device (22) with commercial gas.

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30. Device according to claim 28 or 29, characterized in that the injector pump (21) can be connected to a compressed-medium device (22) which can operate said pump with a compressed-medium pressure of 4,5 - 8,5 bar.

31. Device according to any of claims 1 - 25, characterized in that the vacuum source (9) is an electrically operated vacuum pump.

32. Device according to any of claims 1 - 25, 10 characterized in that the vacuum source (9) is a pump operated by gas.

33. Device according to any of claims 1 - 25, characterized in that the vacuum source (9) is operated by hand.

15 34. Device according to any preceding claim, characterized in that the spongy bone (1) is a spongy vertebra (2).

35. Device according to any preceding claim, 20 characterized in that the spongy bone (1) is a fracture due to osteoporosis.

36. Device according to any of claims 1 - 33, characterized in that the spongy bone (1) is a femoral or knee fracture.

37. Device according to any preceding claim, 25 characterized in that the rinsing agent (7) is a sodium chloride solution.

38. Device according to any preceding claim, characterized in that the rinsing agent (7) contains a detergent.

30 39. Device according to any preceding claim, characterized in that the rinsing agent (7) contains at least one trombolytic substance, e.g. heparin, streptokinase, urokinase, TPA and/or other substances dissolving coagulum and thrombi.

35 40. Device according to any of claims 1 - 35, characterized in that the rinsing agent (7) is distilled water.

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41. Device according to any preceding claim, characterized by a device (9 and/or 30) for imparting pulse like suction and/or insertion movements to the bone substitute and/or bone reinforcing material (3) into the hole (5) in the spongy bone (1).

42. Device according to any preceding claim, characterized by a device (9 and/or 30) for imparting reciprocating suction and/or insertion movements to the bone substitute and/or bone reinforcing material (3) into the hole (5) in the spongy bone (1).

43. Device according to any preceding claim, characterized by a device (9 and/or 30) for pulse like suction and/or feeding of the rinsing agent (7) through the hole (5) in the spongy bone (1).

44. Bone substitute and/or bone reinforcing material which can be applied or provided in a hole (5) in spongy bone (1) in which a vacuum is generated, characterized in that a component forming part of the bone substitute and/or bone reinforcing material (3) is a mineral material or substantially mineral material or a ceramic or substantially ceramic material.

45. Bone substitute and/or bone reinforcing material according to claim 44, characterized in that the mineral material or ceramic material is a hardenable mineral or ceramic which can be brought to harden in the spongy bone (1).

46. Bone substitute and/or bone reinforcing material according to claim 45, characterized in that the mineral material or ceramic can be brought to harden by being mixed with a hardening agent such as water.

47. Bone substitute and/or bone reinforcing material according to any of claims 44-46, characterized in that the mineral material or ceramic is selected from the group comprising calcium sulphate- α -hemihydrate, calcium sulphate- β -hemihydrate,

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calcium sulphate-dihydrate, calcium carbonate, α -tricalcium phosphate, hydroxyapatite, dicalcium phosphate-dihydrate, anhydrous dicalcium phosphate, tetracalcium phosphate, β -tricalcium phosphate, calcium deficient

5 hydroxyapatite, monocalcium phosphate-monohydrate, monocalcium phosphate, calcium-pyrophosphate, precipitated hydroxyapatite, carbonaceous apatite (dahlite), octacalcium phosphate, amorphous calcium phosphate, oxyapatite, carbonato apatite and calcium aluminate.

10 48. Bone substitute and/or bone reinforcing material according to any of claims 44-47, characterized in that an X-ray contrast agent is mixed with the ceramic material.

15 49. Bone substitute and/or bone reinforcing material according to claim 48, characterized in that the X-ray contrast agent is water soluble and non-ionic.

20 50. Bone substitute and/or bone reinforcing material according to claim 49, characterized in that the water soluble, non-ionic X-ray contrast agent is selected from the group comprising iohexol, ioversol, iopamidol, iotrolan, metrizamide, iodocimol, ioglucon, iogluconamide, iogluconide, iogluconamide, iomeprol, iopentol, iopromide, iosarcoll, iosityl, iotusal, ioxilan, 25 iofrotal and iodocol.

30 51. Bone substitute and/or bone reinforcing material which can be applied or provided in a hole (5) in spongy bone (1) in which a vacuum is generated, characterized in that the bone substitute and/or bone reinforcing material (3) is a bone cement including the components polymer, preferably of polymethylmethacrylate (PMMA)-type, and monomer, preferably of methylmethacrylate (MMA)-type, which components harden to bone cement after mixing with each other and feeding 35 into the hole (5) of the spongy bone (1).

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52. Bone substitute and/or bone reinforcing material according to claim 51, characterized in that the bone substitute and/or bone reinforcing material (3) consists of mineral and/or ceramic in combination with polymer material.

53. Method for providing spongy bone with bone substitute and/or bone reinforcing material, characterized in that at least one hole (5) is made in the spongy bone (1), that the hole (5) is flushed or rinsed with rinsing agent (7), and that a vacuum is generated in the hole (5) for sucking and/or facilitating insertion or feeding of the bone substitute and/or bone reinforcing material (3) into the hole (5).

54. Method according to claim 53, characterized in that a vacuum is generated in the hole (5) for sucking rinsing agent (7) through said hole (5).

55. Method according to claim 53 or 54, characterized in that the rinsing agent (7) is brought to flush tissue material and other material away from the sides (5a) of the hole (5) such that depressions (5b) are formed therein and that bone substitute and/or bone reinforcing material (3) is brought to penetrate into said depressions (5b).

56. Method for providing spongy bone with bone substitute and/or bone reinforcing material (3), which is applied or provided in at least one hole (5) in the spongy bone (1) in which a vacuum is generated, characterized in that the bone substitute and/or bone reinforcing material (3) is brought to pulsate during its application in the spongy bone (1).

57. Method according to claim 56, characterized in that reciprocating movements are imparted to the bone substitute and/or bone reinforcing

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material (3) during its application in the hole (5) in the spongy bone (1).

58. Method for providing spongy bone with bone substitute and/or bone reinforcing material (3), which 5 is applied or provided in at least one hole (5) in the spongy bone (1) in which a vacuum is generated and wherein the hole (5) is flushed or rinsed with rinsing agent (7) before application therein of the bone substitute and/or bone reinforcing material (3), characterized 10 in that the rinsing agent (7) is sucked pulsatingly through the hole (5) in the spongy bone (1) by generating a pulsating vacuum in said hole (5).